Grass invader reduces biodiversity and alters ecosystem functions

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Biological invasions as agents of global environmental change

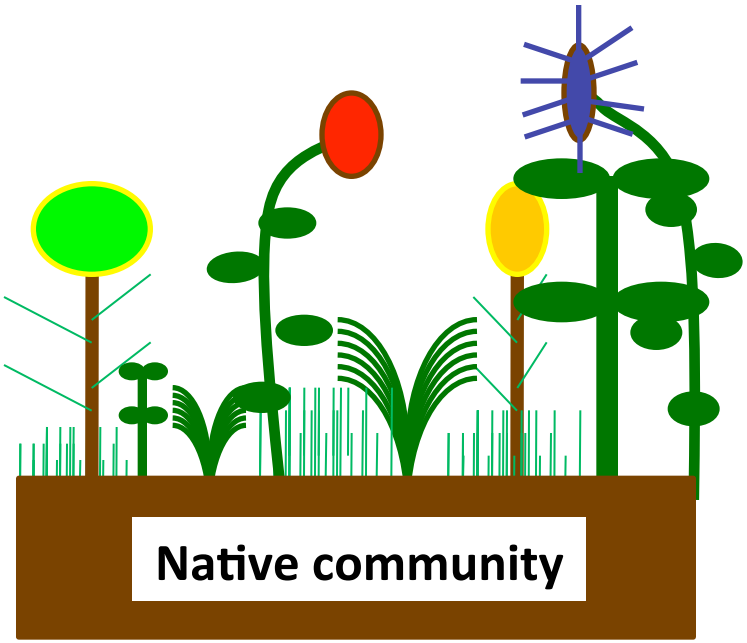
Potential effects:

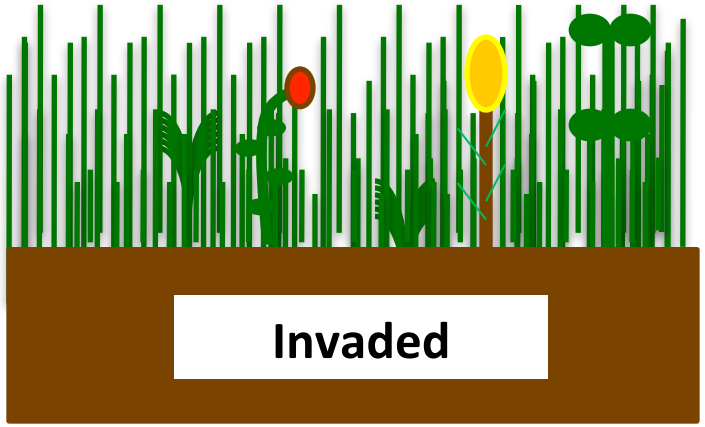
- Declines in biodiversity and habitat quality
- Changes in ecosystem functions
- Pathogen epidemics/outbreaks

***Invasions provide unique opportunities for ecological and evolutionary research**

Invasive species as ‘drivers’ vs. ‘passengers’

- Research often comparative between invaded and invader-free areas





Approaches to evaluating effects of biological invasions

1. Comparative – invaded and invader-free areas

- Quick and easy
- Provide broad patterns
- Cause and effect may be hard to disentangle

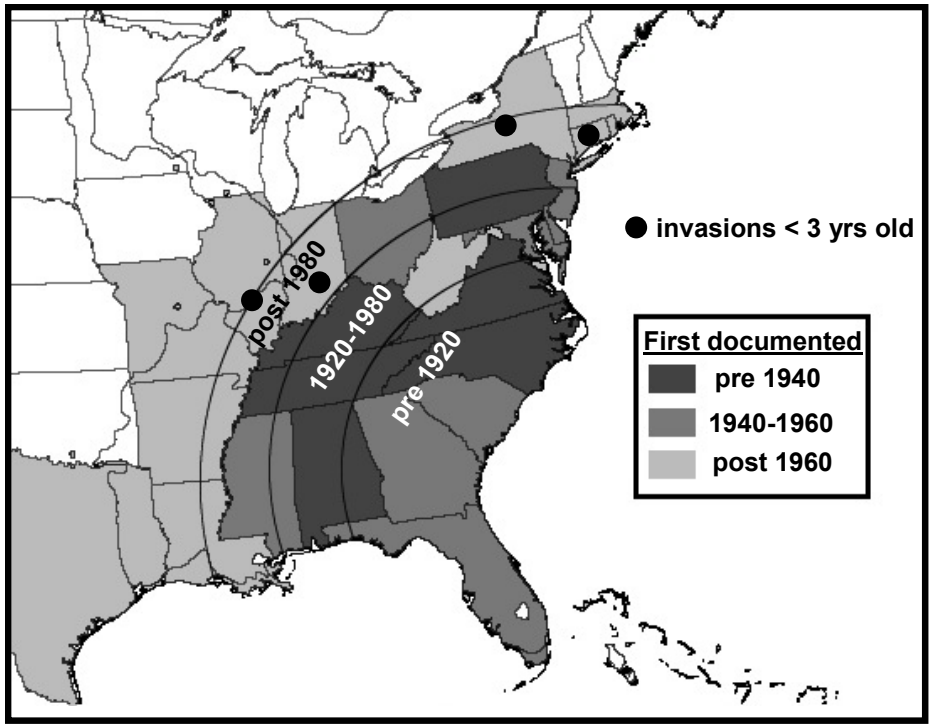
2. Removal experiments

- Removal method may determine results
- Possible effects of invasion that cannot be removed

3. Experimental invasions

- Provide controlled, realistic situation
- Ethical concerns

Microstegium vimineum (Japanese stiltgrass)



Characteristics

- Annual “warm season” grass
- Shade tolerant
- Produces millions seeds/m^2
- Native to southeast Asia
- Few herbivores/pathogens

Microstegium invades a wide range of habitats

- disturbed riparian areas, along streams and rivers
- roadsides, trails
- shaded undisturbed forests and full sun habitats

Wildlife opening

Jackson-Washington State Forest, IN

Forest understory

Big Oaks National Wildlife Refuge, IN

Big Oaks National Wildlife Refuge, IN

Outline

1. Removal experiment
2. Experimental invasion
3. Fire and invasions
4. Pathogens on *Microstegium*

Removal Experiment
Methods

4 Treatments

Reference (control)

Hand-weeding

POST herbicide

POST + PRE herbicide

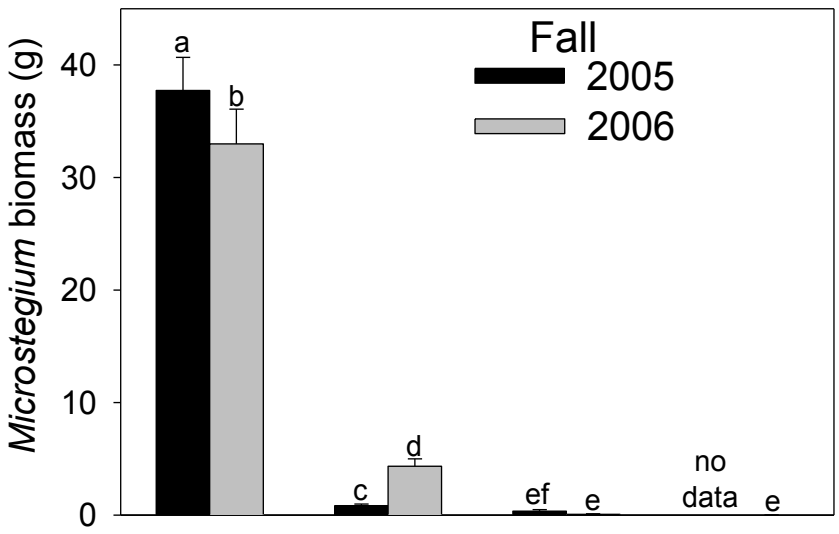
2m

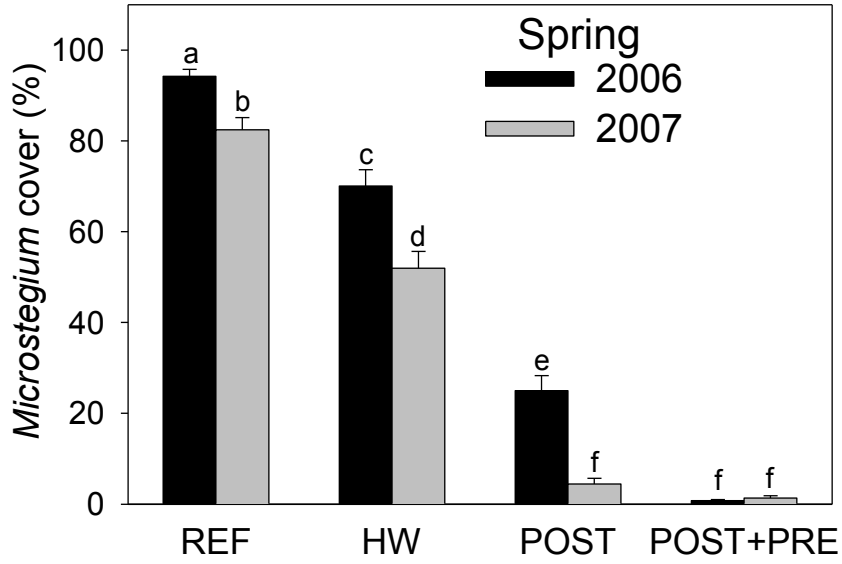
2m

Grass specific Post-emergent herbicide plus Pre-emergent herbicide

Flory, S.L, *Restoration Ecology*, 2008
Flory, S.L and K. Clay *Journal of Applied Ecology*, 2009

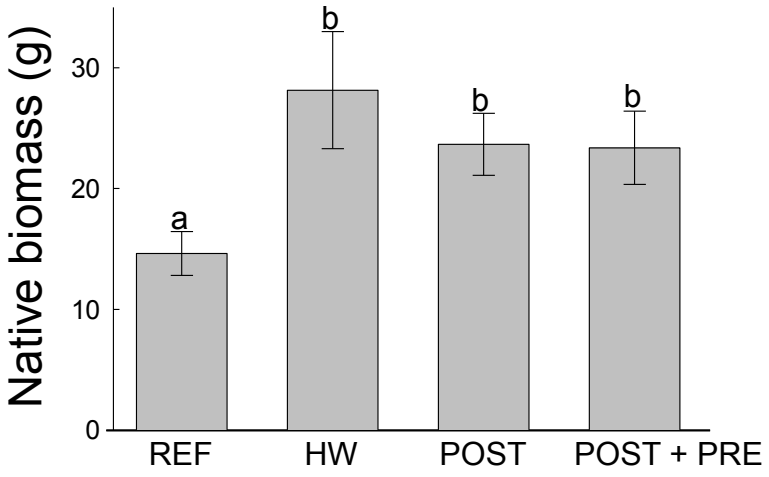
Results: Efficiency of removal

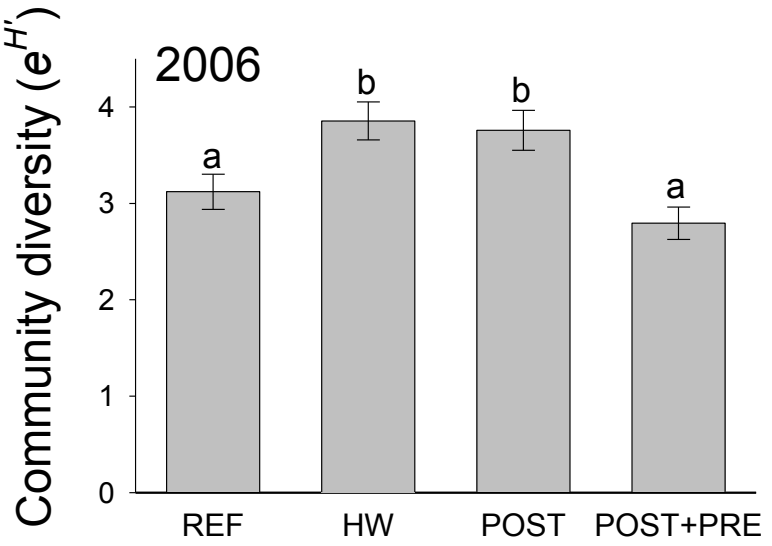


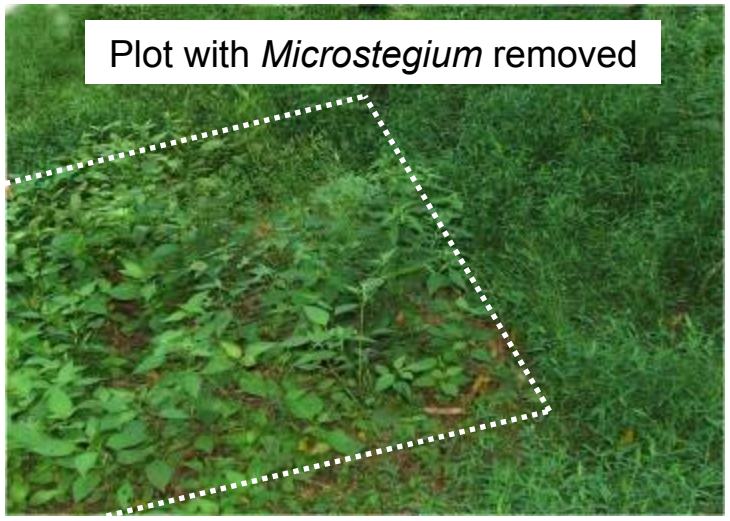


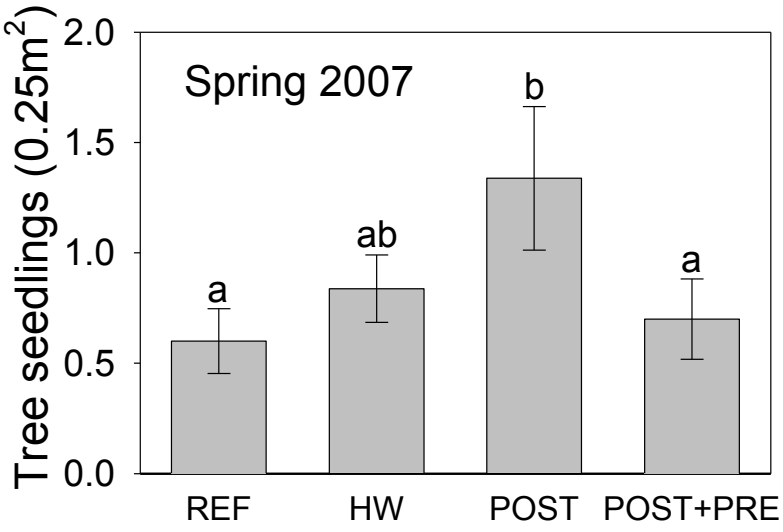
Flory, S.L, *Restoration Ecology*, 2010

Results: Native community responses









Flory, S.L and K. Clay *Journal of Applied Ecology*, 2009

Management of *Microstegium* invasions

- *Microstegium* can be effectively and efficiently removed using grass specific herbicide
- Removal of *Microstegium* results in the return of native species and increases in tree regeneration
- Return of native species suggests suppression by *Microstegium*

Invasion experiment: Design

All plots

9 tree sp

12 herb sp

tree saplings	tree saplings + ***Microstegium***
tree seeds	tree seeds + ***Microstegium***

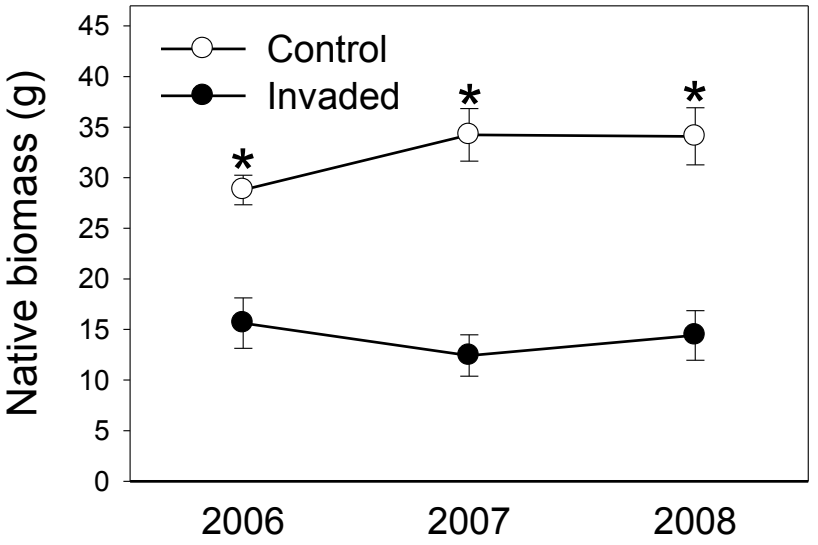
x 8 replicates

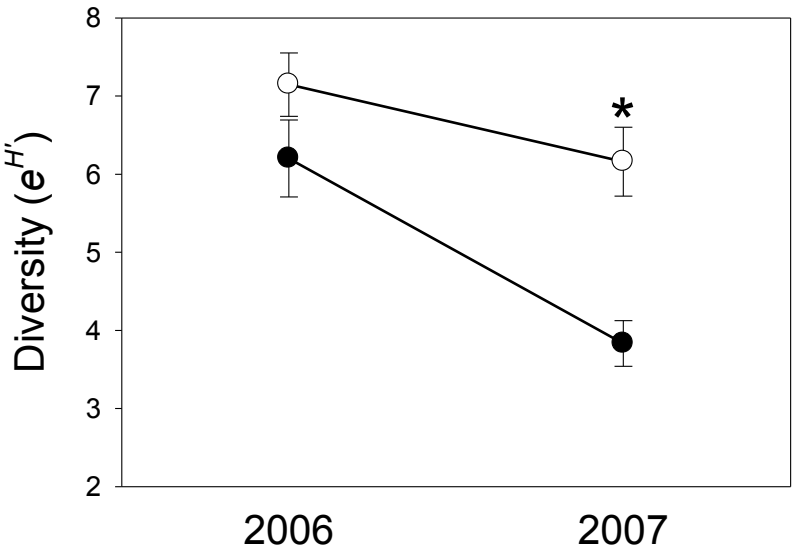
Control

Invaded

IU Research and
Teaching Preserve
Bayles Road

Results: *Microstegium* reduces native plant productivity and diversity

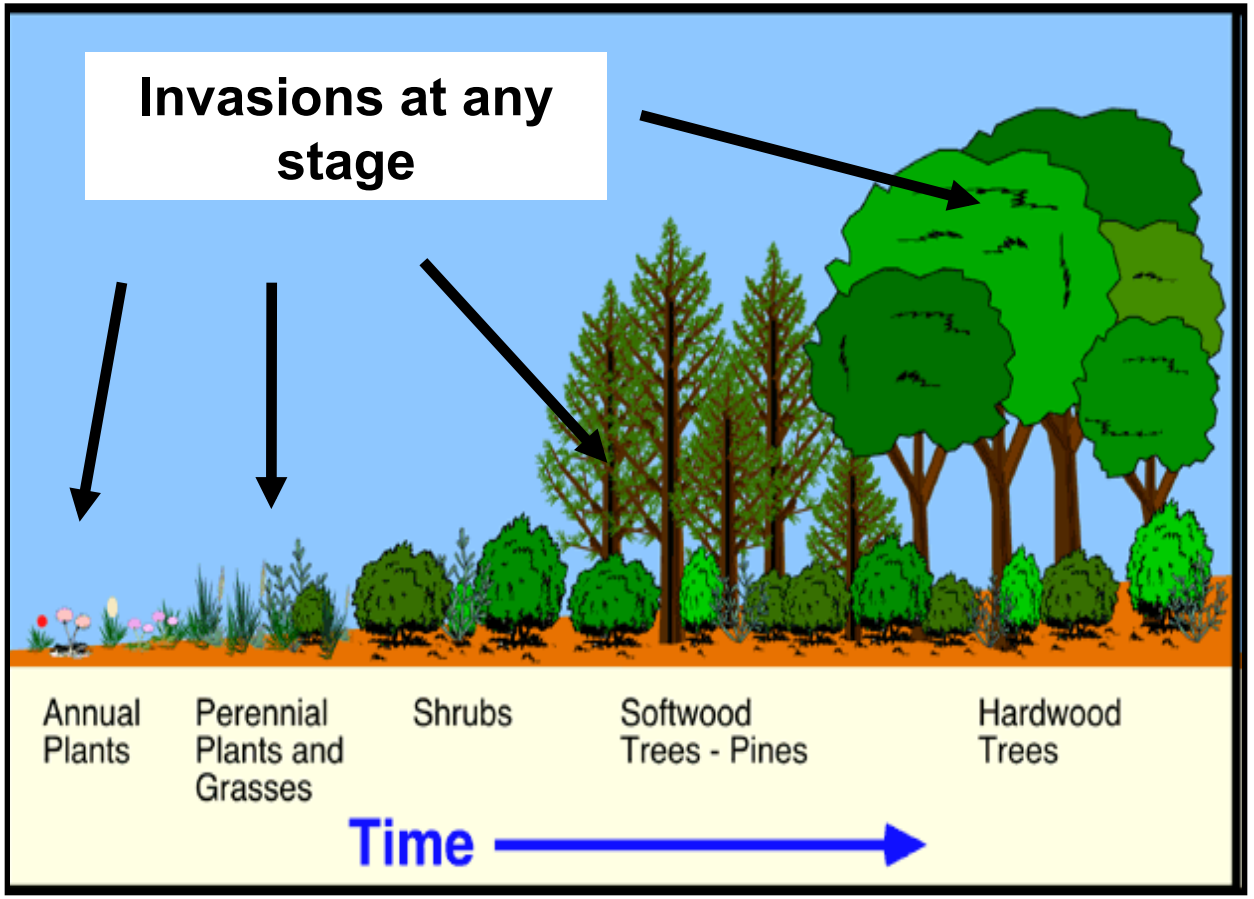




Flory, S.L and K. Clay *Biological Invasions*, 2010

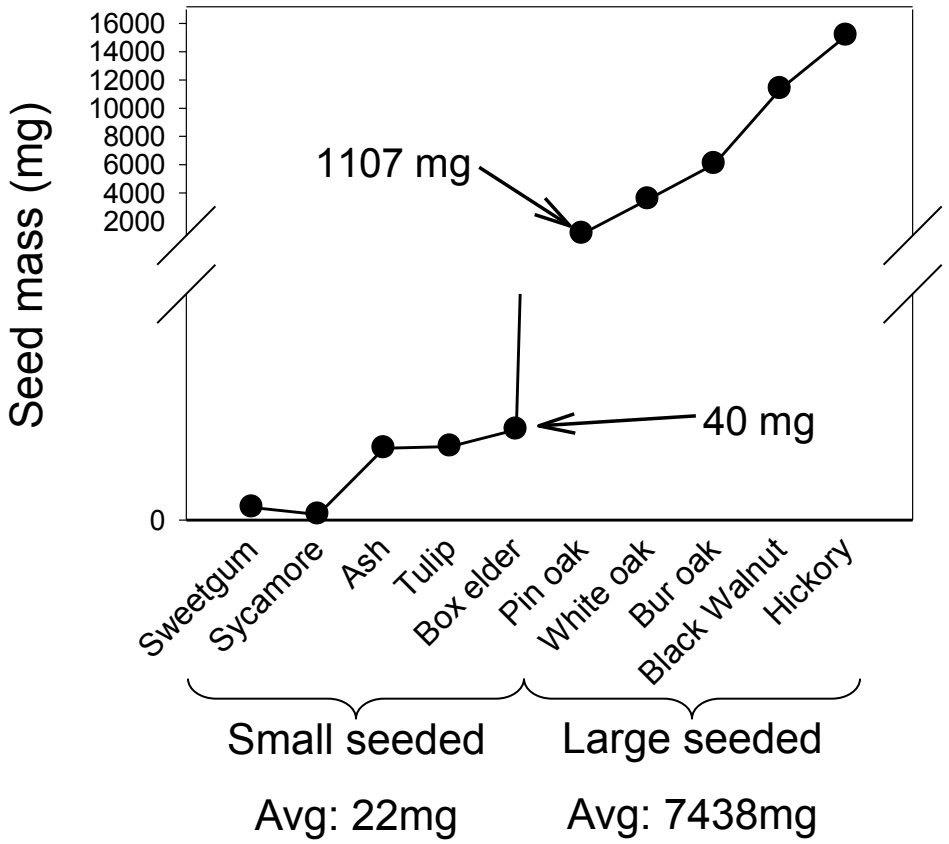
Life history stage (seeds vs saplings)

Microstegium



Prediction: stronger effects on seeds than saplings

Seed size (small vs large seeded)

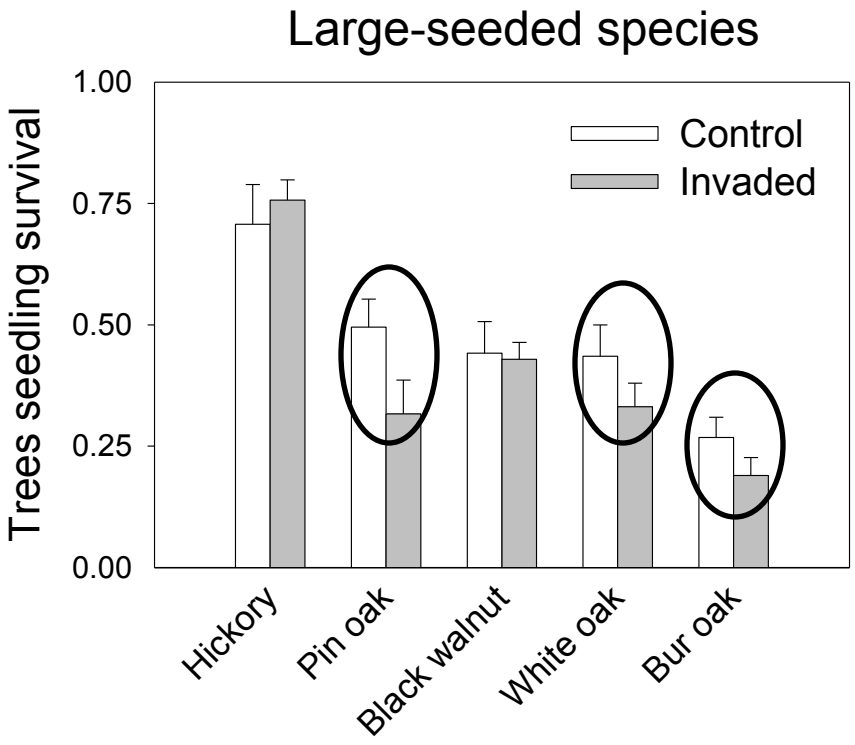


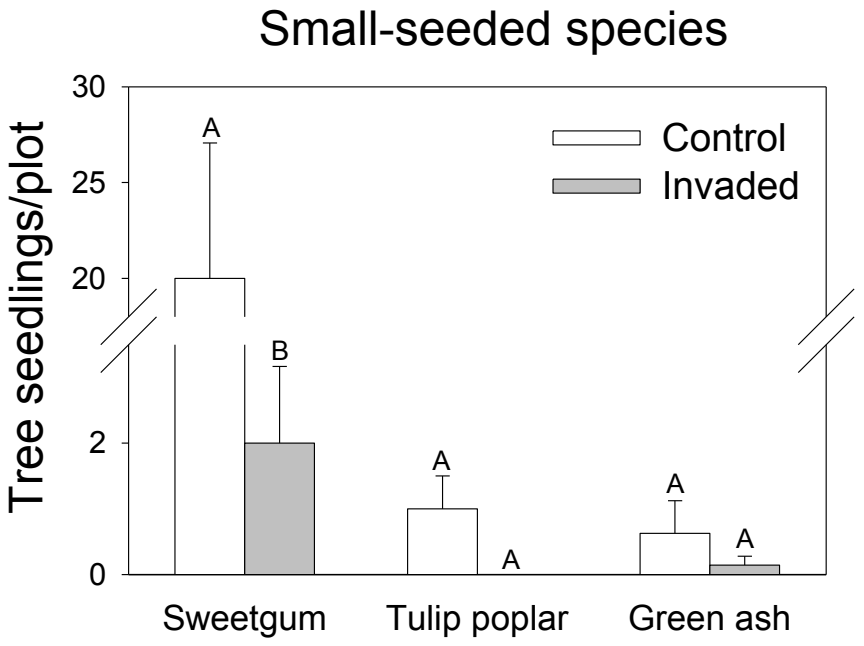
Black walnut

Ash

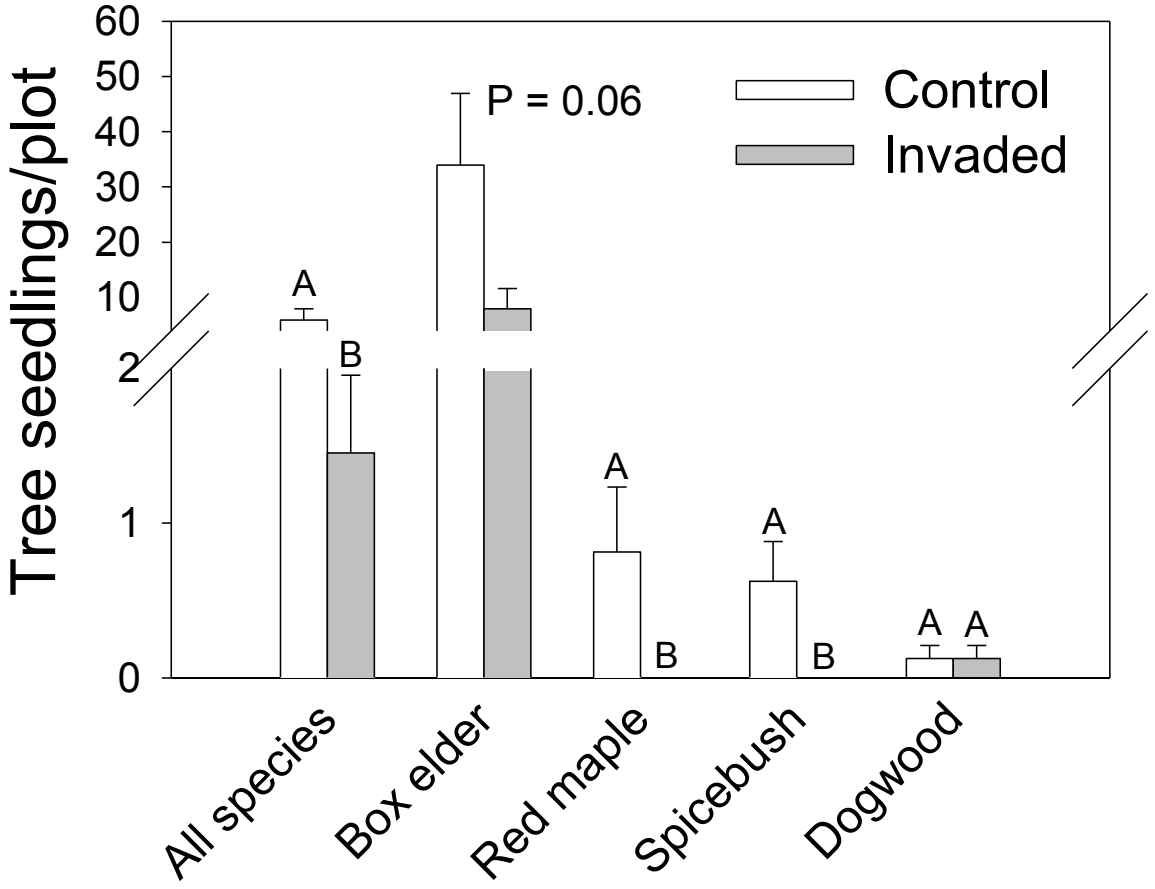
Prediction: stronger effects on small-seeded species

Microstegium inhibits small-seeded tree regeneration





Microstegium reduces natural tree regeneration



*No effect on the survival or growth of tree saplings

Potential mechanisms

- Changes in light availability
- Altered native herbivore behavior
- Nitrogen cycling
- Accumulation of *Microstegium* thatch

Results: *Microstegium* reduces arthropod abundance and diversity

Carolina Simao
Undergraduate at
Rice University

Simao, C., Flory, S.L and J. Rudgers, *Oikos* 2010

Results: *Microstegium* reduces the survival of two tick species

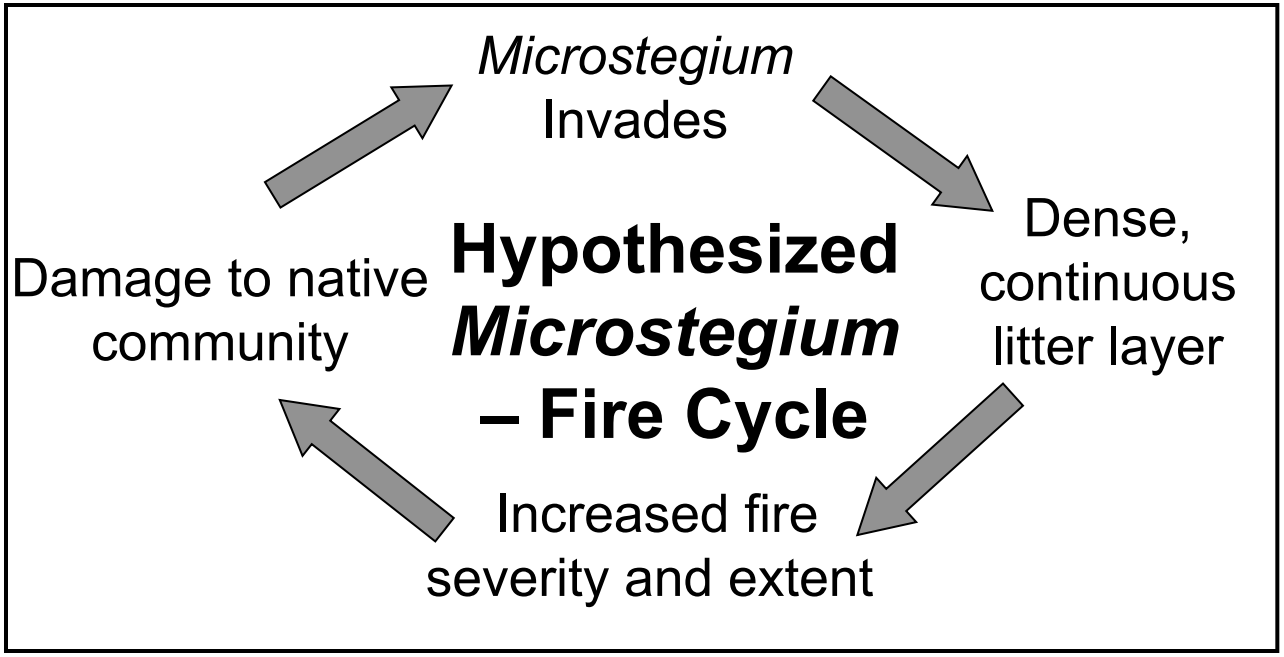
Dave Civitello
Indiana University

Civitello, D., S.L. Flory and K. Clay
Journal of Medical Entomology, 2008

Consequences of *Microstegium* invasion

- ✓ Native plant diversity
- ✓ Forest succession
- ✓ Arthropod diversity
- • Nutrient dynamics
- ✓ Decomposition
- ✓ Disease vectors
- ✓ Fire behavior
- • Carbon storage

Fire and *Microstegium* invasions



Joint Fire Science Program

Microstegium invasions increased prescribed fire intensity

- Increased peak fire temperature
- Higher flame heights
- Greater percent of habitats burned

Identification of a *Microstegium* pathogen

***Bipolaris* sp.**

Conclusions

1. Biological invasions can have significant consequences for native biodiversity and habitats

2. Experimental methods are needed to determine if invaders are actually *causing* negative effects; such data may help motivate changes in policy and management

4. Managers must quickly locate and remove invasions such as *Microstegium* to minimize detrimental effects

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- B.F. Floyd Summer Fellowship
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- Indiana University Research and Teaching Preserve

Research Sites

- Big Oaks National Wildlife Refuge
- Hoosier National Forest
- Morgan-Monroe State Forest
- Jackson-Washington State Forest
- Indiana University RTP
- Ft. Harrison State Park
- The Sycamore Land Trust
- Yellowwood State Forest

Field Assistants

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